In the United States Court of Federal Claims

OFFICE OF SPECIAL MASTERS

Filed: November 14, 2023

JEFFREY W. SPRENGER,	*	PUBLISHED
	*	
Petitioner,	*	No. 18-279V
	*	
v.	*	Special Master Nora Beth Dorsey
	*	
SECRETARY OF HEALTH AND HUMAN SERVICES,	*	Ruling on Entitlement; Pneumococcal Conjugate ("Prevnar 13") Vaccine; Guillain-Barré Syndrome ("GBS").
	*	
Respondent.	*	
	*	

Cary Michael Toland, Herrman and Herrman, PLLC, Brownsville, Texas, for Petitioner.
Ryan Daniel Pyles, U.S. Department of Justice, Washington, DC, for Respondent.

RULING ON ENTITLEMENT[1]

On February 22, 2018, Jeffrey W. Sprenger ("Petitioner") filed a petition for compensation under the National Vaccine Injury Compensation Program ("Vaccine Act" or "the Program"), 42 U.S.C. § 300aa-10 et seq. (2018),[2] alleging that he suffered Guillain-Barré Syndrome ("GBS") as the result of an influenza ("flu") vaccination he received on October 9,

[1] Because this Ruling contains a reasoned explanation for the action in this case, the undersigned is required to post it on the United States Court of Federal Claims' website and/or at https://www.govinfo.gov/app/collection/uscourts/national/cofc in accordance with the E-Government Act of 2002. 44 U.S.C. § 3501 note (2018) (Federal Management and Promotion of Electronic Government Services). **This means the Ruling will be available to anyone with access to the Internet.** In accordance with Vaccine Rule 18(b), Petitioner has 14 days to identify and move to redact medical or other information, the disclosure of which would constitute an unwarranted invasion of privacy. If, upon review, the undersigned agrees that the identified material fits within this definition, the undersigned will redact such material from public access.

[2] The National Vaccine Injury Compensation Program is set forth in Part 2 of the National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, 100 Stat. 3755, codified as amended, 42 U.S.C. §§ 300aa-10 to -34 (2018) ("Vaccine Act" or "the Act"). All citations in this Ruling to individual sections of the Vaccine Act are to 42 U.S.C.A. § 300aa.

2016 and a pneumococcal conjugate ("Prevnar 13") vaccination he received on April 12, 2017.[3] Petition at Preamble, ¶¶ 2, 16 (ECF No. 1). Respondent argued against compensation, stating "this case is not appropriate for compensation under the terms of the Act." Respondent's Report ("Resp. Rept.") at 1 (ECF No. 26).

After carefully analyzing and weighing the evidence presented in accordance with the applicable legal standards, the undersigned finds Petitioner has provided preponderant evidence that the Prevnar 13 vaccine he received caused his GBS, satisfying his burden of proof under Althen v. Secretary of Health & Human Services, 418 F.3d 1274, 1280 (Fed. Cir. 2005). Accordingly, Petitioner is entitled to compensation.

I. ISSUES TO BE DECIDED

Diagnosis is at not in issue. "[R]espondent does not dispute [P]etitioner's diagnosis of GBS." Resp. Brief on Entitlement ("Resp. Br."), filed Apr. 4, 2023, at 13. (ECF No. 99).

The parties dispute causation. Petitioner contends he has provided preponderant evidence that the Prevnar 13 vaccination caused his GBS, and that this evidence meets the Althen criteria. Petitioner's ("Pet.") Br., filed Mar. 21, 2013, at 1, 10 (ECF No. 96). Respondent disagrees and argues Petitioner (1) failed to present a reliable medical theory causally connecting vaccination and GBS, (2) failed to show a logical sequence of cause and effect between vaccination and his GBS, and (3) failed to show a proximate temporal relationship between Petitioner's vaccinations and his GBS. Resp. Br. at 13-26.

II. BACKGROUND

A. Procedural History

Petitioner filed her petition on February 22, 2018, and filed medical records in the following months.[4] Petition; Pet. Exhibits ("Ex.") 1-34. Respondent filed his Rule 4(c) Report arguing against compensation on June 12, 2019. Resp. Rept. at 1.

On November 6, 2019, Petitioner filed an expert report from Dr. Gary Pekoe. Pet. Ex. 37. On February 10, 2020, Respondent filed an expert report from Dr. You-Wen He. Resp. Ex. A. Petitioner filed supplemental expert reports from Dr. Pekoe on April 9, 2020 and January 11,

[3] Petitioner also alleges that a shingles vaccine, Zostavax, administered on April 12, 2017, is causally related to his GBS. Petition at Preamble, ¶¶ 2, 16. However, Zostavax is not a vaccine covered under the Vaccine Injury Table. See, e.g., Scanlon v. Sec'y of Health & Hum. Servs., 114. Fed. Cl. 135, 142 (2013); 42 C.F.R § 100.3(a). Additionally, Petitioner no longer seeks compensation based on receipt of the flu vaccination he received in October 2016, and his claim is based solely on the Prevnar 13 vaccination he received on April 12, 2017. See Petitioner's Brief on Entitlement ("Pet. Br."), filed Mar. 21, 2023 (ECF No. 96).

[4] Petitioner continued to file medical records throughout the course of litigation.

2021. Pet. Exs. 39, 46. On April 5, 2021, Respondent filed a responsive report from Dr. He, and Petitioner filed a supplemental report from Dr. Pekoe on June 11, 2021. Resp. Ex. D; Pet. Ex. 42.

On February 4, 2022, the case was reassigned to the undersigned. Notice of Reassignment dated Feb. 4, 2022 (ECF No. 52). A status conference was held on February 24, 2022 during which the undersigned gave her preliminary opinions on the case. Order dated Feb. 24, 2022 (ECF No. 53). The undersigned preliminarily found the basis for Dr. Pekoe's opinions unpersuasive. Id. at 2. While the undersigned noted the case was not fully developed at that time, the parties agreed to resolve the matter through a ruling on the record after additional expert reports were filed. Id. at 3.

Petitioner filed an expert report by Dr. Lawrence Steinman on June 28, 2022. Pet. Ex. 57. On October 13, 2022, Respondent filed expert reports by Dr. He and Dr. Dara Jamieson. Resp. Exs. E, U.

On November 18, 2022, Petitioner filed a status report indicating he did not wish to file additional expert reports and that the case was ready for submission on the issue of entitlement. Pet. Status Rept., filed Nov. 18, 2022 (ECF No. 88). Respondent filed a joint status report on December 19, 2022 with an agreed upon briefing schedule and indicated he was investigating the feasibility of a potential settlement. Resp. Joint Status Rept., filed Dec. 19, 2022 (ECF No. 90). However, on January 20, 2023, Respondent advised he declined to entertain settlement negotiations at that time and reiterated the proposed briefing schedule—simultaneous briefs on the merits, followed by permissive replies. Resp. Joint Status Rept., filed Jan. 20, 2023 (ECF No. 94).

On March 21, 2023, Petitioner filed his brief for a ruling on the record on entitlement. Pet. Br. Respondent filed his brief on April 4, 2023. Resp. Br. On April 18, 2023, Petitioner filed a reply. Pet. Reply to Resp. Br. ("Pet. Reply"), filed Apr. 18, 2023 (ECF No. 100).

This matter is now ripe for adjudication.

B. Medical Terminology

GBS is an illness that causes "acute flaccid paralysis, characterized by symmetrical weakness of the limbs, and hyporeflexia or areflexia, which reaches a maximum severity within [four] weeks []. Sensory symptoms, such as [] numbness, usually start distally and have a symmetrical pattern." Resp. Ex. A, Tab 1 at 1.[5] A common subtype of GBS is "acute inflammatory demyelinating polyneuropathy (AIDP)." Id. The condition is relatively rare, with a reported incidence of 0.89-1.89 cases per 100,000 person-years in Western countries, affecting

[5] Bianca van den Berg, Guillain-Barré Syndrome: Pathogenesis, Diagnosis, Treatment and Prognosis, 10 Nature Revs. Neurology 469 (2014).

all ages, with an increased risk in older adults. Resp. Ex. R at 1.[6] Most patients have symptoms that progress for one to three weeks after initial symptoms begin. Id. at 3. The majority are "unable to walk independently when maximum weakness is reached." Id. Respiratory difficulty and other complications may occur. Id. Patients may have a severe clinical course, and 20% are unable to walk for up to six months after onset. Id. Weakness is the prominent manifestation. Id. Other symptoms may include sensory disturbances, cranial nerve palsies, and dysautonomia.[7] Id. at 9.

GBS is thought to be an autoimmune disease. Pet. Ex. 67 at 1.[8] "[T]he immune system starts to destroy the myelin sheath that surrounds the axons of [] peripheral nerves." Id. The axons of nerves may also be affected. Id. Once the myelin sheath or axons of the peripheral nerves are injured, the nerves are unable to send signals in the usual fashion. Id. "[M]uscle weakness and tingling sensations" occur in the "hands and feet and progress upwards." Id. GBS may be triggered by infections or immunizations. Id.; see also Resp. Ex. Z at 1 ("[A]proximately two-thirds of all cases are preceded by a gastrointestinal or respiratory infection within the prior [three] months.").[9]

The underlying etiology of GBS "is considered to be an immune-mediated disorder resulting from generation of autoimmune antibodies and/or inflammatory cells which cross-react with epitopes on peripheral nerves and roots, leading to demyelination or axonal damage or both." Resp. Ex. CC at 2.[10] In an article filed by Respondent, the way infection and vaccines may cause GBS is described below:

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[6] Nobuhiro Yuki & Hans-Peter Hartung, Guillain-Barré Syndrome, 366 New Eng. J. Med. 2294 (2012).

[7] Dysautonomia is a "malfunction of the autonomic nervous system." Dysautonomia, Dorland's Med. Dictionary Online, https://www.dorlandsonline.com/dorland/definition?id=15146 (last visited Oct. 26, 2023). Autonomic nervous system is "the portion of the nervous system concerned with regulation of the activity of cardiac muscle, smooth muscle, and glandular epithelium; usually restricted to the two visceral efferent peripheral components, the sympathetic nervous system, and the parasympathetic nervous system." Autonomic Nervous System, Dorland's Med. Dictionary Online, https://www.dorlandsonline.com/dorland/definition?id=111779 (last visited Oct. 26, 2023).

[8] Nat'l Inst. Neurological Disorders & Stroke, Guillain-Barré Syndrome Fact Sheet https://www.ninds.nih.gov/guillain-barre-syndrome-fact-sheet (last updated Aug. 26, 2014).

[9] Roger Baxter et al., Lack of Association of Guillain-Barré Syndrome with Vaccinations, 57 Clinical Infectious Diseases 197 (2013).

[10] James J. Sejvar et al., Guillain-Barré Syndrome and Fisher Syndrome: Case Definitions and Guidelines for Collection, Analysis, and Presentation of Immunization Safety Data, 29 Vaccine 599 (2011).

> The concept of "molecular mimicry" involves a situation in which epitopes of a pathogen or vaccine protein could initiate development of antibodies and/or T-cells that could cross-react with epitopes on peripheral nerve myelin or axonal glycoproteins or ganglioside moieties. Activated macrophages could potentially be targeted to antigens on the myelin sheath and subsequently invade the basement membrane resulting in demyelination or, alternatively, invade at the nodes of Ranvier[11] to result in axonal damage.

Id. at 3.

C. Summary of Medical Records[12]

Prior to vaccination, Petitioner's medical history included fatigue, a well-controlled seizure disorder, and diabetes mellitus type II (metformin prescribed for diabetes in August 2016). Pet. Ex. 29 at 71-74, 87; Pet. Ex. 33 at 36-38, 47, 50-52. On October 9, 2016, at 59 years old, Petitioner received a flu vaccination. Pet. Ex. 3 at 1.

On November 21, 2016, Petitioner was seen in primary care for bloodwork and did not have any concerns or complaints at that time. Pet. Ex. 29 at 90. He had "equal [and] present" sensation in his lower extremities. Id. On November 29, 2016, Petitioner was seen in primary care for a cough for the previous five days, lack of energy, chest congestion, and headache. Id. at 91. The assessment was bronchitis. Id. On December 30, 2016, Petitioner returned for the same symptoms, with a month's duration. Id. Petitioner reported that he had improved for two weeks, but then developed an enlarged prostate for which he was receiving care from a urologist and was on Bactrim and Flomax. Id. The assessment again was bronchitis. Id. at 92.

On January 3, 2017, Petitioner presented to Memorial Hermann Hospital for a one-day history of a rash after recently starting a steroid dose pack and Bactrim to "treat his prostate." Pet. Ex. 30 at 12, 45. Petitioner's musculoskeletal sensation was intact, and he had no weakness on a review of systems. Id. at 20, 45. The assessment was a likely allergic reaction to Bactrim, and the plan was to switch Bactrim to Cipro if Petitioner's urologist concurred. Id. at 48. In a

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[11] The nodes of Ranvier are "constrictions occurring on myelinated nerve fibers at regular intervals of about 1 mm; at these sites the myelin sheath is absent and the axon is enclosed only by Schwann cell processes." Nodes of Ranvier, Dorland's Med. Dictionary Online, https://www.dorlandsonline.com/dorland/definition?id=93095 (last visited Oct. 26, 2023). Schwann cells are "any of the large nucleated cells whose cell membrane spirally enwraps the axons of myelinated peripheral neurons and is the source of myelin; a single Schwann cell supplies the myelin sheath between two nodes of Ranvier." Schwann Cell, Dorland's Med. Dictionary Online, https://www.dorlandsonline.com/dorland/definition?id=64407 (last visited Oct. 26, 2023).

[12] This summary of medical records is quoted verbatim from Respondent's Brief, as the undersigned finds it to be an accurate representation of the records. Resp. Br. at 3-7.

follow-up with primary care on January 4, 2017 for "hives all over body [for] three days," Petitioner was prescribed the antihistamine, Atarax. Pet. Ex. 29 at 92.

On February 27, 2017, Petitioner was seen in primary care for a cough, nasal congestion, body aching, and headache for the previous three days. Pet. Ex. 29 at 92.[13] The assessment was an upper respiratory infection, and Petitioner was prescribed a Z-Pak, Flonase, an Albuterol inhaler, and Robitussin. Id. at 93. A flu test was noted to be negative. Id. On March 2, 2017, Petitioner called his primary provider's office to refill Robitussin. Id. On March 22, 2017, the primary care office prescribed Petitioner fluticasone, a nasal steroid. Id.

Petitioner received the Prevnar 13 vaccine and a shingles vaccine (Zostavax) on April 12, 2017. Pet. Ex. 4 at 1.

On April 27, 2017, Petitioner saw his primary care provider for numbness in his hands, feet, and lips. Pet. Ex. 29 at 93. Petitioner's numbness was of a two-day duration. Id. at 88. He also reported neck pain of a four-day duration. Id.

Petitioner presented to Memorial Hermann Hospital on April 29, 2017 for a four- to five-day history of "numbness/tingling to [his] bilateral feet and ankles, hands and wrists." Pet. Ex. 30 at 123. The symptoms seemed to wax and wane but were progressively worsening. Id. He also reported bilateral face numbness. Id. He felt like he was "'tasting salt' all the time." Id. In a hospital-based neurology consultation with Dr. Atta Rehman, Petitioner reported being diagnosed with diabetes about six months prior. Id. at 86. Petitioner continued that he "started having numbness and tingling in his feet Tuesday [April 25] when he was vacationing in Las Vegas that according to him traveled up to his legs and he noticed some numbness in his hands as well." Id. The history continued that on the next day (April 26), he felt an "off-balance feeling" and "left-sided low back pain." Id. In the hospital, Petitioner was prescribed gabapentin, and he was discharged on May 1, 2017. Id. at 95, 143. A lumbar puncture had not showed evidence of GBS. Id. at 96. The discharge diagnoses were "[p]aresthesia likely secondary to diabetic neuropathy [versus GBS]," sciatica, accelerated hypertension, diabetes, hyperlipidemia, a seizure disorder, and gastroesophageal reflux. Id.

On May 2, 2017, Petitioner saw his primary care provider with a complaint of "getting weaker, cannot walk," and he was referred to a neurologist. Pet. Ex. 29 at 89. That same day, Petitioner saw neurologist Dr. Jose Diaz. Pet. Ex. 33 at 54. The assessment was GBS, and Petitioner was to be admitted for plasmapheresis. Id. Petitioner was readmitted to Memorial Hermann Hospital from May 2-9, 2017. Pet. Ex. 30 at 430, 545-46. The discharge diagnoses included GBS, and Petitioner was discharged to inpatient rehabilitation. Id. at 430, 1382. Petitioner was in inpatient rehabilitation until May 24, 2017. Pet. Ex. 42 at 6-12.

In follow-up with Dr. Diaz on July 12, 2017, Petitioner was "doing much better after plasmapheresis and rehab" and "continu[ed] to improve with physical therapy." Pet. Ex. 33 at 58. Petitioner specifically reported facial and throat numbness. Id. On examination, strength

[13] The record is cut off, but it appears that Petitioner had been exposed to sick contacts ("+ sick . . . work"). Pet. Ex. 29 at 92-93.

was 4/5 in all four extremities; Petitioner had no deep tendon reflexes; and he had decreased sensation in his distal legs and feet. Id. Petitioner reported April 25, 2017 as the onset of his symptoms associated with GBS. Id. Dr. Diaz noted, "[b]ased on the timing and sequence of events, [Petitioner's] GBS is most likely secondary to the vaccinations received on April 12, 2017." Id. Petitioner was to continue on gabapentin. Id.

On January 10, 2018, Dr. Diaz reported that Petitioner's "extremity strength [had] significantly improved," and Petitioner had no breathing or swallowing difficulty. Pet. Ex. 33 at 80. However, he "remain[ed] with some discomfort[,] including discomfort over his face and around his eyes." Id. On examination, Petitioner's strength was 5/5; his deep tendon reflexes were 2+ and "symmetric with cross adductors;" Petitioner's sensory examination was "intact;" and he had a normal gait. Id. The assessment was GBS with continued, slow improvement and hyperreflexia. Id. at 81. Dr. Diaz noted that Petitioner had been completely areflexic, and accordingly, hyperreflexia was "concerning for the possibility of a central pathology including the possibility of disseminated encephalomyelitis." Id. Accordingly, he ordered cervical and brain MRIs. Id. A January 29, 2018 cervical-spine MRI showed cervical spondylosis, but no enhancements to indicate, for example, encephalomyelitis. Id. at 100. A brain MRI on the same date was unremarkable. Id. at 102.

On May 11, 2018, the "Department of Assistive and Rehabilitative Services" sent Petitioner to occupational medicine specialist Dr. Faiyaz Bhojani. Pet. Ex. 33 at 215-18. Petitioner complained of continued tightness and numbness in his feet, hands, and around his nose and eye areas. Id. at 215. He also complained of "severe fatigue," a lack of sleep, poor balance, and a feeling of jerking movement. Id. Dr. Bhojani concluded in part that

> [i]n regards to the ability to perform work-related functions of [a] physical nature, [Petitioner] is able to sit for long periods of time, stand for short to moderate periods of time and walk short to moderate distances and lift light to moderate weights. [Petitioner's] fine finger control is within normal limits and [he] is able to hear, speak, and have conversation which is fluent and understandable. [Petitioner's] gait is broad with a slight right limp and he can do toe and heel walking for a few steps, as well as tandem walking but no squatting. His grip strength is good and he can reach, finger and handle [sic] but his feeling sensation is decreased. . . . There is no reproducible fatigue on motor examination during examination.

Id. at 218.

On July 12, 2018, in follow-up with Dr. Diaz, Petitioner complained of tingling in his hands, feet, and nose. Pet. Ex. 33 at 125. His feet felt heavy; he complained of fatigue; and he felt he had balance issues when standing and starting walking. Id. The bottom of his feet felt sore if he stood in place for very long. Id. He had hand tremors since his last visit in January. Id. Petitioner reported short-term memory issues and difficulty getting words out at times. Id. Dr. Diaz did not feel petitioner was worsening, or that IVIG was warranted. Id. at 126.

As of December 6, 2022, as noted during a follow-up visit with Dr. Diaz, Petitioner reported numbness in his feet, left lower leg, hands, and in his nose area that was unchanged since his prior visit in April 2022. Pet. Ex. 93 at 1. He reported a "slight tremor" in his hands "at times." Id. The assessment included that Petitioner had a "significant residual component" with regard to GBS symptomatology—that he had improved, but never returned to baseline. Id. at 3. He was on gabapentin (600 mg, three times daily) for "neuropathic discomfort." Id. (also noting that gabapentin "significantly helped his pain and discomfort").

No other relevant medical records were filed.

D. Affidavits

On December 1, 2017, Petitioner executed an affidavit. Pet. Ex. 28 at 6. Petitioner recalled that on October 9, 2016, he received a flu vaccine and thereafter, "began to feel weakness, fatigue, coughing and chest congestion[,] and some numbness in [his] extremities." Id. at ¶ 1. He felt like he had the flu but a flu test was negative. Id. He averred he "felt the same symptoms through 2017." Id.

In preparation for travel to visit his sister, Petitioner received the Prevnar 13 vaccine and a shingles vaccine on April 12, 2017. Pet. Ex. 28 at ¶ 2. Toward the end of his week-long visit, he "began noticing an increase in the symptoms that had been with [him] since November: a severe tingling in [his] hands and feet as though they were asleep, and [he] experienced difficultly with walking and balancing." Id. at ¶ 3. On April 27, Petitioner noted he "felt an increase of the numbness and tingling up [his] arms, hands, nose, lips[,] and legs, and [his] balance issues were becoming more severe. Later in the day, [he] began to experience sharp pains up [his] legs and was unable to get comfortable, and [he] was severely fatigued." Id. He recalled the numbness, tingling, and pain continued to worsen the next day and on April 29, he "was weak and could not walk without assistance." Id.

Petitioner described his hospital course from admission on April 29, 2017 to discharge on May 1, 2017, including the spinal tap that was negative for elevated proteins. Pet. Ex. 28 at ¶¶ 4-5. During the evening after his discharge, Petitioner could not stand or walk. Id. at ¶ 5. His neurologist, Dr. Diaz saw him on May 2, assessed him with GBS, and was sent to the emergency room. Id. at ¶ 6. After being admitted to the hospital again on May 2, 2017, Petitioner received plasmapheresis infusions, had a spinal tap that was positive for elevated proteins, and was diagnoses with GBS. Id. at ¶ 7. Petitioner recalled that "[d]uring this time, [his] weakness, paralysis, numbness[,] and pain dramatically increased." Id. He "continued deteriorating until approximately May 9[] when [he] appeared to have reached a plateau." Id.

Lastly, Petitioner recounted that on May 9, 2017, he was transferred to inpatient rehabilitation, and on May 24, he transitioned to outpatient rehabilitation. Pet. Ex. 28 at ¶¶ 8-9.

E. Expert Reports[14]

1. Petitioner's Expert, Dr. Lawrence Steinman[15]

a. Background and Qualifications

Dr. Steinman is board certified in neurology and has practiced neurology at Stanford University for over 40 years. Pet. Ex. 57 at 1; Pet. Ex. 58 at 1-2. He received his B.A. from Dartmouth College in 1968 and his M.D. from Harvard University in 1973. Pet. Ex. 58 at 1. Thereafter, he completed an internship in surgery, residency in pediatrics, and residency in pediatric and adult neurology from Stanford University Hospital, as well as three fellowships, including one in clinical immunology. Id. Dr. Steinman is currently a Professor at Stanford University. Id. Dr. Steinman treats patients with GBS. Pet. Ex. 57 at 1. He has authored or co-authored over 500 publications. Pet. Ex. 58 at 5-47. Dr. Steinman has authored papers on molecular mimicry, as demonstrated by his CV. Id.; see also Pet. Ex. 57 at 1. One of Dr. Steinman's specialties is in the area of multiple sclerosis ("MS"), and he has received a Charcot Prize for Lifetime Achievement due to his research in MS. Pet. Ex. 57 at 2. In 2015, he was elected to the National Academy of Sciences. Id. Dr. Steinman is also a member in the National Academy of Medicine. Id.

b. Opinion

i. Althen Prong One

Dr. Steinman opined that the Prevnar 13 vaccination can cause GBS. Pet. Ex. 57 at 32. The focus of Dr. Steinman's expert reports and opinions was how the Prevnar 13 vaccine can trigger GBS via molecular mimicry. Id. at 11. He reviewed the components of the vaccine and the main targets of the human immune response in GBS and proposed two mechanisms whereby molecular mimicry can trigger GBS following Prevnar 13 vaccination. The first involves homology between the components in the vaccine and phosphoglycerol components in the myelin of peripheral nerves. Id. at 12-21. The second involves homology between CRM_{197} in the vaccine and Contactin-1, a protein found in humans. Id. at 21-31.

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[14] Although the undersigned has reviewed all the expert reports, for the sake of brevity this Ruling does not include every detail of the experts' opinions. Instead, the undersigned focuses on the experts' material opinions, as they relate to the relevant issue of causation.

[15] Petitioner filed one expert report from Dr. Steinman. Pet. Ex. 58. Petitioner also filed four expert reports from Gary Pekoe, Ph.D. Immunopharmacologist. Pet. Exs. 37, 39, 42, 46. Petitioner stated in his brief that "his claim relies on [Dr.] Steinman's expert report and medical theory that the Prevnar 13 vaccination on April 12, 2017[] caused his vaccine injury." Pet. Br. at 10 n.1. "Accordingly, Petitioner will not be discussing nor submitting any theories put forth by Petitioner's initial expert, [Dr. Pekoe,] regarding vaccinations received outside of temporal relevance to Petitioner's GBS (i.e. the Flulaval Quad vaccine)." Id. Therefore, the undersigned will not discuss Dr. Pekoe's reports or opinions and will limit her discussion and analysis to the Prevnar 13 vaccination and the theories offered by Dr. Steinman.

1. Phosphoglycerol[16] in Serotypes 18C and 23F

The first mechanism described by Dr. Steinman involves homology between phosphoglycerol in the Prevnar 13 vaccine, present in the antigens of *Streptococcus pneumoniae* ("*S. pneumoniae*") serotypes 18C and 23F, and phospholipids, specifically glycerophosphate and glycerocholine in the human myelin sheath. Pet. Ex. 57 at 12-16; see also Pet. Ex. 69 at 24 (Prevnar 13 package insert).

Based upon information obtained from the vaccine patent,[17] Dr. Steinman explained that the glycerol phosphate side chains in the vaccine are necessary for its immunogenicity.[18] Pet. Ex. 57 at 14-15. Dr. Steinman cited an article by Chang et al.[19] to support his opinion that the phosphoglycerol component is preserved during the process of making the vaccine. Id. (citing Pet. Ex. 72 at 1). Chang et al. wrote "it is shown that glycerol-phosphate must be preserved for conserving adequate antigenicity of the 18C capsular polysaccharide." Pet. Ex. 72 at 1.

Dr. Steinman explained how the data from the vaccine patent and the studies described above relate to the pathogenesis of GBS. Pet. Ex. 57 at 12-13. He opined that phospholipids[20] are the targets of antibodies in GBS. Id. He asserted that antibodies to phosphoglycerol structures interact with myelin components triggering GBS. Id. at 13. Based on his own research, Dr. Steinman explained that "phospholipids are components of the myelin sheath in humans, and they are targeted by antibodies" leading to neuroinflammation in GBS. Id.

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[16] Phospho- is a "prefix[] indicating the presence of phosphorus in a compound." Stedman's Medical Dictionary 1486 (28th ed. 2006). Glycerol is "[a] sweet viscous fluid obtained by the saponification of fats and fixed oils; used as a solvent, as a skin emollient, . . . and as a vehicle and sweetening agent." Stedman's at 820.

[17] The patent is filed as Petitioner's Exhibit 74. The description of the glycerol phosphate side chain in 18C can be found at page 34, and a diagram of the chemical structure is at page 6.

[18] Immunogenicity is defined as "the property that endows a substance with the capacity to provoke an immune response, or the degree to which a substance possesses this property." Immunogenicity, Dorland's Med. Dictionary Online, https://www.dorlandsonline.com/dorland/definition?id=24893 (last visited Oct. 26, 2023).

[19] Janoi Chang et al., Relevance of O-acetyl and Phosphoglycerol Groups for the Antigenicity of the *Streptococcus pneumoniae* Serotype 18C Capsular Polysaccharide, 30 Vaccine 7090 (2012).

[20] Phospholipid is defined as "any lipid that contains phosphorus, including those with a glycerol backbone (phosphoglycerides and plasmalogens) . . . . Phospholipids are the major form of lipid in all cell membranes." Phospholipid, Dorland's Med. Dictionary Online, https://www.dorlandsonline.com/dorland/definition?id=38759 (last visited Nov. 1, 2023).

In support of this aspect of his opinion, Dr. Steinman relied on several articles. The first was authored by Ho et al.[21] and Dr. Steinman is also a named author. Pet. Ex. 65. The authors showed that in the demyelinating disease MS, autoantibodies primarily target a phosphoglycerol component of myelin. Pet. Ex. 57 at 13 (citing Pet. Ex. 65 at 1). The "findings indicate[d] that myelin phospholipids are targeted by autoimmune responses in MS." Pet. Ex. 65 at 9.

In Gilburd et al.,[22] the authors "studied the reactivity of GBS sera with various phospholipids which are known to be important constituents of myelin and serve as autoantigens in other autoimmune conditions." Pet. Ex. 70 at 2. Six of the 16 patients with GBS had autoantibodies to various phospholipids. Id. at 2, 5. However, the authors suggested this was "probably [] a result of [] myelin damage rather than [the] cause of demyelination." Id. at 2, 6.

Nakos et al.,[23] studied anti-phospholipid antibodies in nine patients with GBS. Pet. Ex. 71 at 1. All nine patients in the study had anti-phospholipid antibodies and no such antibodies were detected in the nine control subjects. Id. The authors "detected a wide range of anti-phospholipid antibodies in patients with idiopathic GBS," and "[a]ll nine GBS patients developed anti-phospholipid antibodies directed against at least one lipid during the course of the disease." Id. at 5. They wrote, "[t]he association of GBS and certain autoimmune diseases, including systemic lupus erythematosus, is well recognized," and they noted "[h]igh levels of anti-phospholipid antibodies were expressed in a patient with lupus like syndrome who developed secondary GBS." Id. at 6. The authors explained that "[i]t is thought that whenever polyneuropathy occurs in the context of autoimmune diseases, mainly in systemic lupus erythematosus, where anti-phospholipid activity already exists, these antibodies can cross-react with phospholipids and mediate damage in neural structures containing the particular phospholipids." Id. Of note, the GBS patients in the Nakos et al. study had primary GBS (relevant here), not the secondary form like that which occurs in patients with lupus. Id. The authors also observed anti-ganglioside antibodies, but only in 44% of the patients. Id. They concluded,

> [i]t is not well understood whether these anti-phospholipid antibodies play a role in the pathogenesis of the polyneuropathy or represent a part of a more extensive immunoreaction that takes place in the GBS. However, immunopathology in autopsies suggests that antibody mediated injury is a predominant disorder in the demyelinating form of GBS. The immune attack is directed against components of Schwann cell membrane and is accompanied by the characteristic feature of vesicular demyelination. Therefore, it is crucial to

[21] Peggy P. Ho et al., Identification of Naturally Occurring Fatty Acids of the Myelin Sheath That Resolve Neuroinflammation, 4 Sci. Translational Med. 1 (2012).

[22] B. Gilburd et al., Autoantibodies to Phospholipids and Brain Extract in Patients with the Guillain-Barré Syndrome: Cross-Reactive or Pathogenic?, 16 Autoimmunity 57 (1993).

[23] G. Nakos et al., Anti-Phospholipid Antibodies in Serum from Patients with Guillain-Barré Syndrome, 31 Intensive Care Med. 1401 (2005).

> investigate how anti-phospholipid antibodies are related to specific antigens in Schwann cell membrane.
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> . . . .
>
> Our findings suggest that in GBS there is a more extensive immune reaction, beyond the well known antiganglioside production, which has been related to the demyelination of the peripheral nerves.

Id. at 6-7.

Lastly, Dr. Steinman cited a study by Bryson et al.[24] of antibodies directed to serotype 23F "from humans who were immunized with a pneumococcal vaccine (Pneumovax 23) that contains 23F."[25] Pet. Ex. 57 at 17 (citing Pet. Ex. 75 at 2). He explained Bryson et al. showed X-rays of "human antibody targeting the 23F component of *S. pneumonia*." Id. (citing Pet. Ex. 75 at 2). Dr. Steinman opined the X-rays demonstrate the "human antibody response to 23F after the human received a pneumococcal vaccine intended to elicit antibodies to 23F." Id. at 18. Dr. Steinman concluded that the "data from the Bryson [et al.] article demonstrate unequivocally that the immune response to the serotype 23F component of Pneumovax 23 targets the phosphoglycerol in serotype 23F." Id. at 20 (emphasis omitted).

In summary, Dr. Steinman's theory is based on molecular mimicry, and he averred that antibodies to the phosphoglycerol structures present in the components of Prevnar 13 (via serotypes 18C and 23F) target an immune response in phospholipids in the myelin components of peripheral nerves, triggering GBS. Pet. Ex. 57 at 21.

2. CRM_{197} and Contactin-1

[24] Steve Bryson et al., Structures of Preferred Human IgV Genes–Based Protective Antibodies Identify How Conserved Residues Contact Diverse Antigens and Assign Source of Specificity to CDR3 Loop Variation, 196 J. Immunology 4723 (2016).

[25] Serotype 23F is included in both Prevnar 13 and Pneumovax 23. See Pet. Ex. 69 (Prevnar 13 package insert); Pet. Ex. 77 (Pneumovax 23 package insert).

The second homology posited by Dr. Steinman is between the protein carrier in the vaccine, CRM_{197},[26] and Contactin-1,[27] a protein found in humans. Pet. Ex. 57 at 21. Prevnar 13 is a conjugate vaccine in which the individual polysaccharides of the capsular antigens of *S. pneumoniae* are linked to a non-toxic diphtheria CRM_{197} protein. Id. at 12 (citing Pet. Ex. 69 at 24). "CRM_{197} is a nontoxic variant of diphtheria toxin," used as a protein carrier which makes the vaccine more immunogenic. Id. (quoting Pet. Ex. 69 at 24). CRM_{197} differs from diphtheria toxin by only one amino acid, the enzymatically active domain of the toxin, and therefore, it is not toxic. Id. at 12, 28, 31; see also Pet. Ex. 88 at 1.[28]

Again, based on his own research, Dr. Steinman determined that molecular mimicry might occur between CRM_{197} and Contactin-1, a molecule that has been identified in patients with GBS. Pet. Ex. 57 at 21. Dr. Steinman relied on Miura et al., a study done on patients with CIDP. Id. (citing Pet. Ex. 79). Miura et al. focused their research on patients with CIDP, but used sera from patients with GBS, MS, and healthy patients as controls. Pet. Ex. 79 at 2. They found that five of the 200 patients with GBS had anti-Contactin-1 Immunoglobulin G ("IgG") antibodies. Id. at 3, 6 tbl.2.

The Miura et al. authors explained the theory of pathogenesis relevant to Dr. Steinman's theory, as it relates to Contactin-1. They stated,

> [c]ell adhesion molecules play a crucial role in the formation of the nodes of Ranvier and in the rapid propagation of the nerve impulses along myelinated axons. In the peripheral nerves, the domain organization of myelinated axons depends on specific axo-glial contacts between the axonal membrane and Schwann cells at nodes, paranodes[,] and juxtaparanodes.

Pet. Ex. 79 at 2.

Miura et al. identified Contactin-1 (CNTN1) as one of the targets of autoantibodies in some patients with GBS. Pet. Ex. 79 at 3. Based on this information about the potential

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[26] Protein carrier "CRM_{197} is a nontoxic variant of diphtheria toxin isolated from cultures of *Corynebacterium diphtheriae* strain C7 (β197) grown in a casamino acids and yeast extract-based medium." Pet. Ex. 69 at 24 (Prevnar 13 package insert).

[27] Contactin-1, or CNTN1, "is a key axonal adhesion molecule, which interacts with CNTNAP1 (previously known as Caspr1) on the axon and neurofascin-155 on the glial side, and is essential for the formation of the paranodal septate-like junction." Pet. Ex. 79 at 2 (Yumako Miura et al., Contactin I IgG4 Associates to Chronic Inflammatory Demyelinating Polyneuropathy with Sensory Ataxia, 138 Brain 1484 (2015)).

[28] Michael Bröker et al., Biochemical and Biological Characteristics of Cross-Reacting Material 197 (CRM_{197}), a Non-Toxic Mutant of Diphtheria Toxin: Use as a Conjugation Protein in Vaccines and Other Potential Clinical Applications, 39 Biologicals 195 (2011).

importance of Contactin-1, Dr. Steinman conducted a BLAST[29] search to determine whether there was homology between CRM_{197} in the vaccine and Contactin-1.[30] Pet. Ex. 57 at 21. He found a sequence[31] that "might be capable of inducing a neuroinflammatory disease." Id. at 27. He found it is an epitope in diphtheria toxin, which provides the basis for CRM_{197}. Id. at 28-30. After additional research, Dr. Steinman identified another sequence[32] that "has known cross-reactivity with epitopes described in humans" on the *Corynebacterium diphtheriae* microbe. Id. at 30.

Dr. Steinman opined the two sequences he found were significant due to five identical amino acids in a nervous system protein. Pet. Ex. 57 at 21-22. He cited a number of papers, including some that he authored or co-authored, to support his opinion that homology of just five amino acids can induce an immune response consistent with his theory here. Id. For example, in his 1993 paper,[33] Dr. Steinman wrote that "[a]n autoimmune response can begin even if the molecular mimicry is not quite exact." Pet. Ex. 87 at 4. He cited the Gautam et al. studies[34] for the proposition that autoimmune encephalomyelitis could be induced with only five amino acids identical to myelin basic protein, out of short sequences of 10 amino acids. Pet. Ex. 57 at 21. (citing Pet. Exs. 80-82, 87).

In summary, Dr. Steinman averred that this theory provides "actual detailed data for molecular mimics in the CRM in the Prevnar 13 vaccine" and how "these mimics could trigger inflammatory neuropathy culminating in GBS." Pet. Ex. 57 at 31 (emphasis omitted).

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[29] A BLAST (Basic Local Alignment Search Tool) search "finds regions of similarity between biological sequences. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance." BLAST, https://blast.ncbi.nlm.nih.gov/Blast.cgi (last visited Nov. 1, 2023).

[30] For a complete explanation of Dr. Steinman's investigation, including his discussion on the number of amino acids required for homology relevant to molecular mimicry as well as the procedure he followed in conducting his BLAST searches, see Pet. Ex. 57 at 21-27.

[31] The sequence is "WEQAKALSVE," which "has five of ten identical amino acids." Pet. Ex. 57 at 27.

[32] The second sequence is "EYMAQACAGNRVRR." Pet. Ex. 57 at 30.

[33] Lawrence Steinman, Autoimmune Disease, 269 Sci. Am. 106 (1993).

[34] Anand M. Gautam et al., A Polyalanine Peptide with Only Five Native Myelin Basic Protein Residues Induces Autoimmune Encephalomyelitis, 176 J. Experimental Med. 605 (1992); Anand M. Gautam et al., Minimum Structural Requirements for Peptide Presentation by Major Histocompatibility Complex Class II Molecules: Implications in Induction of Autoimmunity, 91 Immunology 767 (1994); Anand M. Gautam et al., A Viral Peptide with Limited Homology to a Self Peptide Can Induce Clinical Signs of Experimental Autoimmune Encephalomyelitis, 161 J. Immunology 60 (1998). Dr. Steinman is a named author in all of these papers.

3. Medical Literature

After setting forth his theories, Dr. Steinman offered additional medical literature, a case report, and a paper from the Centers for Disease Control and Prevention ("CDC") in support of his opinions. Pet. Ex. 57 at 32. He cited a case report published by Ravishankar[35] about a patient who developed GBS about one month after her pneumococcal vaccination. Id. (citing Pet. Ex. 90 at 1). He also cited a 2016 CDC publication authored by Haber et al.[36] reporting 11 cases of GBS after the Prevnar 13 vaccination. Id. (citing Pet. Ex. 91). There were 11 reports of GBS, one in patients aged 19 to 64, and 10 in the age range of 65 and older. Pet. Ex. 91 at 3 tbl.2a, 4 tbl.2b. Median onset was nine days post-vaccination and median patient age was 68 years. Id. at 4. Dr. Steinman stated that the paper "reinforces the likelihood that molecular mimicry following Prevnar 13 vaccination can cause GBS." Pet. Ex. 57 at 32 (citing Pet. Ex. 91).

Dr. Steinman concluded that GBS is "a relatively rare illness. Numerous vaccines including Prevnar 13 can in rare instances through the theory of molecular mimicry cause GBS." Pet. Ex. 57 at 32.

ii. Althen Prong Two

Regarding a logical sequence of cause and effect, Dr. Steinman stated that there is "a logical sequence of cause and effect showing the vaccination was the reason for the injury," since it "has constituents that induce antibodies known to cross-react with myelin and that are found in patients with GBS." Pet. Ex. 57 at 33.

Although Petitioner had an episode of diarrhea before he became ill, he tested negative for *Clostridioides difficile*, and was not tested for *Campylobacter jejuni*. Pet. Ex. 57 at 32. Dr. Steinman opined that even if Petitioner's diarrhea "contributed to triggering [Petitioner's] GBS, the Prevnar 13 vaccine was a substantial factor in triggering [Petitioner's] GBS." Id. at 32-33.

iii. Althen Prong Three

Petitioner received the Prevnar 13 vaccination on April 12, 2017, and Dr. Steinman stated that according to Dr. Diaz's note, Petitioner had GBS by April 27, 2017. Pet. Ex. 57 at 32. Dr. Steinman further opinioned that this onset was consistent with "the timing known for GBS and the 1976 swine flu immunization, often used as a surrogate in such cases regarding timing." Id.

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[35] Nidhi Ravishankar, Guillain-Barre Syndrome Following PCV Vaccine, 2 Clinics Surgery 1413 (2017).

[36] Penina Haber et al., Post-Licensure Surveillance of 13-Valent Pneumococcal Conjugate Vaccine (PCV13) in Adults Aged ≥19 Years Old in the United States, Vaccine Adverse Event Reporting System (VAERS), June 1, 2012–December 31, 2015, 34 Vaccine 6330 (2016). This is also cited as Resp. Ex. A, Tab 8.

(citing Pet. Ex. 92).[37] He also cited the Haber et al. article in support of his opinion that Petitioner's temporal association between vaccination and GBS onset was appropriate given his proposed mechanism of molecular mimicry. Id. (citing Pet. Ex. 91). Haber et al. reported a median onset of nine days with a range of two to 34 days. Pet. Ex. 91 at 4. Dr. Steinman concluded that the temporal relationship criteria of Althen prong three was fulfilled based on this interval. Pet. Ex. 57 at 33.

2. Respondent's Expert, Dr. Dara G. Jamieson[38]

a. Background and Qualifications

Dr. Jamieson is a board-certified neurologist licensed in New York. Resp. Ex. V at 2. She received her medical degree from the University of Pennsylvania, followed by a neurology residency and a cerebrovascular fellowship at the University of Pennsylvania Hospital. Resp. Ex. U at 1. Dr. Jamieson was a practicing neurologist for 32 years before transitioning to a voluntary faculty appointment in 2018. Id. She is currently a Clinical Associate Professor of Neurology at Weill Cornell Medicine, where she teaches medical students in neurology courses and clinical inpatient clerkships, as well as lectures to residents and fellows. Id. She has also lectured extensively nationally and internationally on neurological topics. Id. at 2; Resp. Ex. V at 4-10. Dr. Jamieson serves on several editorial boards, including the Journal of Neuroimmunology, Current Treatment Opinions in Neurology, and Neurology Alert. Resp. Ex. U at 1-22. She has authored or co-authored numerous publications in peer reviewed journals as well as authored books and book chapters on various neurological topics. Id.; Resp. Ex. V at 10-14.

b. Opinion

Dr. Jamieson offered opinions from the perspective of a neurologist, and deferred to Respondent's immunologist, Dr. He, as to the immunological issues. See Resp. Ex. U at 10.

i. Althen Prong One

Dr. Jamieson first opined that "there is no epidemiological evidence that Prevnar [13] is a trigger for GBS." Resp. Ex. U at 12. Dr. Jamieson cited studies that purported to show that there is no association between vaccinations, including pneumococcal vaccines, and GBS. A brief summary of Dr. Jamieson's opinions related to these studies is set forth below.

[37] Lawrence B. Schonberger et al., Guillain Barré Syndrome Following Vaccination in the National Influenza Immunization Program, United States, 1976-1977, 110 Am J. Epidemiology 105 (1979).

[38] Dr. Jamison submitted one expert report. Resp. Ex. U.

Dr. Jamieson cited Baxter et al., who evaluated the relationship between GBS and vaccinations, including the 23-valent pneumococcal polysaccharide vaccine. Resp. Ex. Z at 1, 4. The authors reviewed records of 415 hospitalized patients diagnosed with GBS from 1995 to 2006. Id. at 1. Of these, 25 had received a vaccine within a six-week period prior to onset of their GBS. Id. at 4. The vaccines included flu (18 patients), 23-valent pneumococcal polysaccharide (two patients),[39] tetanus-diphtheria combination (three patients), and hepatitis A and B (three patients). Id. "[U]sing a case-centered method to control for seasonality and other time-varying confounders, [they] found no evidence of an increased risk of GBS following any vaccination." Id. at 5. The authors acknowledged, however, that the study had "limited power to fully assess the risk of GBS following vaccination due to the rarity of the outcome." Id. at 7. And they concluded that the results "provide reassurance that the risk of GBS following any vaccine . . . is extremely low." Id.

Dr. Jamieson also discussed the study by Chen et al.[40] Resp. Ex. U at 8 (citing Resp. Ex. AA at 1). She asserted that this study conducted between 2011 and 2015 in three Chinese cities found no association between vaccinations and the risk of GBS in pediatric or adult patients. Id.

Specific to the pneumococcal vaccines, Dr. Jamieson cited Tseng et al.,[41] which compared adverse events between the Prevnar 13 vaccine and the 23-valent pneumococcal polysaccharide vaccine. Resp. Ex. U at 9 (citing Resp. Ex. Q at 1). The authors concluded there was no significantly increased risk of GBS after Prevnar 13 when compared with the 23-valent pneumococcal polysaccharide vaccine. Id. (citing Resp. Ex. Q at 1).

Souayah et al.[42] reviewed reports to the Vaccine Adverse Event Reporting System ("VAERS") in 2004 and found 54 cases of GBS post-vaccination, including one report of GBS following the pneumococcal polyvalent vaccine, however, the onset interval was not provided. Resp. Ex. BB at 1. Thus, Dr. Jamison did not find it to provide evidence of causation. Resp. Ex. U at 9.

Haber et al. studied adverse event reports reported to VAERS in adults following the Prevnar 13 vaccine from June 2012 to December 2015. Resp. Ex. U at 9 (citing Pet. Ex. 91). During that time period, there were 2,976 total reports. Id. Most of the reports related to

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[39] Petitioner did not receive this vaccine. However, as evidenced by the package inserts, the Prevnar 13 and 23-valent pneumococcal polysaccharide vaccines contain the same 13 bacterial polysaccharides. See Pet. Exs. 69, 77.

[40] Yong Chen et al., Vaccines and the Risk of Guillain-Barré Syndrome, 35 Eur. J. Epidemiology 363 (2020).

[41] Hung Fu Tseng et al., Pneumococcal Conjugate Vaccine Safety in Elderly Adults, 5 Open Forum Infectious Diseases ofy100 (2018).

[42] Nizar Souayah et al., Guillain-Barre Syndrome After Vaccination in United States A Report from the CDC/FDA Vaccine Adverse Event Reporting System, 24 Vaccine 5253 (2007).

injection site adverse events (injection site pain, redness, and swelling). Pet. Ex. 91 at 3 tbl.1. There were 11 cases of GBS reported following the Prevnar 13 vaccination, and in ten of those, the Prevnar 13 vaccine was the only vaccine administered. Id. at 4. One patient also received a flu vaccine. Id. The authors concluded that their "data mining analysis noted no disproportionate reporting for GBS." Id. at 5. Dr. Jamieson criticized Dr. Steinman's reliance on Haber et al., particularly his opinion that it "reinforces the likelihood of molecular mimicry." Resp. Ex. U at 11 (quoting Pet. Ex. 57 at 32). Instead of supporting Dr. Steinman's theory, Dr. Jamieson believed that the occurrence of GBS is "a coincidental association with an almost universal, annually recurring event, be it vaccination or paying taxes, [and] is to be expected." Id.

In Cordonnier et al.,[43] immunocompromised patients (they had undergone stem cell transplant) were administered Prevnar 13 and 23-valent pneumococcal polysaccharide vaccines. Resp. Ex. DD at 1. One patient developed GBS 29 days after the fourth dose of Prevnar 13 and one day after the 23-valent pneumococcal polysaccharide vaccine. Resp. Ex. DD at 7. Due to the patients' comorbidities, exposure to infections, and other confounders, the authors were unable to establish "a clear causal relationship" between vaccination and GBS. Resp. Ex. U at 9-10 (quoting Resp. Ex. DD at 9).

Dr. Jamieson also cited the Ravishankar case report referenced by Dr. Steinman and argued that the patient did not have GBS since her illness was progressive and the interval between onset and nadir of weakness exceeded the Brighton criteria for GBS. Resp. Ex. U at 10. Thus, Dr. Jamieson argued that the patient had an "undiagnosed prolonged neurological disorder," not GBS, and there was no association between her vaccinations and illness. Id. Dr. Jamieson criticized Dr. Steinman's use of the case report due to the issue she identified with the diagnosis of GBS. Id. at 10-11. Dr. Jamieson also did not agree that the case report provided evidence that the Prevnar vaccine was a substantial factor that triggered GBS in the Petitioner. Id. at 11.

ii. Althen Prong Two

Dr. Jamieson agreed that Petitioner was properly diagnosed with GBS. Resp. Ex. U at 11. She opined that in the winter months of 2016 and 2017, Petitioner had respiratory infections and flu-like symptoms, and that these types of infections are recognized as triggers for GBS. Id. She further opined that, more likely than not, Petitioner's preceding respiratory infections were the cause of his GBS. Id. at 11-12. Dr. Jamieson explained that a "proven trigger of GBS by an infection is a much more reasonable causation for [Petitioner's] GBS than [] an unproven trigger by a vaccine." Id. at 12. She did not identify the date of Petitioner's antecedent infection which she alleged caused Petitioner's GBS or provide any other specific information about the infection that she believed caused Petitioner's GBS.

[43] Catherine Cordonnier et al., Immunogenicity, Safety, and Tolerability of 13-Valent Pneumococcal Conjugate Vaccine Followed by 23-Valent Pneumococcal Polysaccharide Vaccine in Recipients of Allogeneic Hematopoietic Stem Cell Transplant Aged ≥ 2 Years: An Open-Label Study, 61 Clinical Infectious Disease 313 (2015).

Regarding the duration and severity of Petitioner's symptoms, she agreed that he had symptoms of GBS longer than six months, but she asserted that at six months, Petitioner's symptoms were "mild and non-disabling, and primarily sensory. Despite fluctuations in his persistent sensory symptoms," Dr. Jamison opined that Petitioner was not disabled. Resp. Ex. U at 11.

iii. Althen Prong Three[44]

Dr. Jamieson agreed that two weeks after the Prevnar 13 vaccination administered on April 12, 2017, Petitioner had sensory symptoms of GBS that progressed to "mild weakness and areflexia." Resp. Ex. U at 11. She did not refute Petitioner's assertion that there was an appropriate temporal association between Petitioner's Prevnar 13 vaccination and his GBS.

3. Respondent's Expert, Dr. You-Wen He[45]

a. Background and Qualifications

Dr. He is currently a Professor of Immunology at the Department of Immunology at Duke University Medical Center. Resp. Ex. A at 1. Dr. He received his M.D. from the Fourth Military Medical University in Xian, China, and his Ph.D. in Microbiology and Immunology from the University of Miami School of Medicine in Miami, Florida. Resp. Ex. T at 1. His research areas include "innate and adaptive immunity against viral and bacterial infections[,] as well as tumors." Resp. Ex. A at 1. He has conducted research on human immune responses to viral infections and is currently a Co-Principal Investigator for clinical trials focusing on cancer immunotherapy. Id. Dr. He has reviewed National Institutes of Health ("NIH") studies, serves

[44] Dr. Jamison also opined that the onset of Petitioner's GBS was about half a year after his flu vaccination, which is too long to support "any contention that there was a connection" between it and his GBS. Resp. Ex. U at 11. Petitioner no longer asserts that there is a causal connection between his flu vaccine and GBS. See Pet. Br. at 10 n.1.

[45] Dr. He submitted three expert reports. Resp. Exs. A, D, E. Additionally, in Dr. He' s expert reports, he responded to opinions offered by Petitioner's initial expert, Gary Pekoe, Ph.D. However, Petitioner stated in his brief that "his claim relies on [Dr.] Steinman's expert report and medical theory that the Prevnar 13 vaccination on April 12, 2017[] caused his vaccine injury." Pet. Br. at 10 n.1. "Accordingly, Petitioner will not be discussing nor submitting any theories put forth by Petitioner's initial expert, [Dr. Pekoe] regarding vaccinations received outside of temporal relevance to Petitioner's GBS (i.e. the Flulaval Quad vaccine)." Id. Therefore, the undersigned will not discuss Dr. He's opinions offered in response to Dr. Pekoe's opinions but will limit her discussion and analysis to the Prevnar 13 vaccination as proffered by Dr. Steinman. Dr. He's opinions in response to Dr. Steinman's opinions are discussed in his third report. Resp. Ex. E. While the undersigned has reviewed and considered all of Dr. He's opinions, as well as all of the medical literature cited by Dr. He in all three of his reports, this Ruling focuses on the opinions most relevant here, responsive to Dr. Steinman.

on editorial boards, and has authored or co-authored numerous publications. Id. at 1-2; Resp. Ex. T at 2-3, 7-16.

b. Opinion

Dr. He did not dispute Petitioner's diagnosis of GBS. In his summary of the medical records, Dr. He acknowledged that Petitioner was admitted to the hospital on April 29, 2017, was diagnosed with GBS, and received treatment for GBS. See Resp. Ex. A at 3.

i. Althen Prong One

In his first expert report, Dr. He acknowledged that molecular mimicry may play a role in the pathogenesis of GBS. Resp. Ex. A at 3. He stated, "[a]lthough the pathological mechanisms by which GBS develops remain to be firmly established, cross-reactive autoantibodies may play some roles in its immunopathogenesis." Id. He also agreed that the "cross-reactive antibodies may attack peripheral nerves and roots and cause demyelination and axonal damage." Id.

In his second report, however, Dr. He backed away from his support of molecular mimicry, calling it "an old theory [that] has been strongly challenged by recent scientific evidence from large sequencing of proteomes of microbial pathogens." Resp. Ex. D at 7. Based on a paper by Kanduc et al.,[46] Dr. He asserted that "viral and human proteomes have massive peptide sharing," which would cause "a 100% autoimmune disease rate in the general population after either infection or vaccination" if molecular mimicry was a causal mechanism. Id. (citing Resp. Ex. D, Tab 4). Dr. He concluded that "mere sequence similarity cannot be used to . . . [conclude] that vaccines cause autoimmune diseases." Id.

In his third expert report, Dr. He provided responsive comments about Dr. Steinman's two theories, described below.

1. Phosphoglycerol in Serotypes 18C and 23F

First, Dr. He acknowledged that Dr. Steinman proposed that phospholipids in the human myelin sheath was a potential target in GBS. Resp. Ex. E at 2. Citing Gilburd et al. and Nakos et al., Dr. Steinman showed that anti-phospholipids have been detected in GBS patients. Pet. Ex. 57 at 13-14. In response, Dr. He emphasized the conclusion in Gilburd et al. stated that "these autoantibodies are probably produced as a result of the myelin damage rather than [the] cause [of] demyelination." Resp. Ex. E at 3 (quoting Pet. Ex. 70 at 1).

Dr. He did not take issue with Dr. Steinman's description of foundational data showing that the glycerol phosphate side chains in 18C and 23F of the Prevnar 13 vaccine "could be targets for human antibodies." Resp. Ex. E at 4. Specifically, as to Dr. Steinman's opinions related to 23F, Dr. He stated, "[t]hese are elegant studies. I completely agree that the cited studies unequivocally demonstrate[] human immune responses to the serotype 23F and its

[46] Darja Kanduc et al., Massive Peptide Sharing Between Viral and Human Proteomes, 29 Peptides 1755 (2008).

phosphoglycerol group." Id. at 5. However, Dr. He disagreed there was evidence that "cross-reactive antibodies are induced by [Prevnar 13] vaccination." Id. He also opined that even if there was cross-reactivity, there is no evidence that such would lead to pathology and cause GBS. Id. at 5-6.

2. CRM_{197} and Contactin-1

The second homology described by Dr. Steinman was between the protein carrier in the vaccine, CRM_{197}, and Contactin-1, a protein found in humans. Pet. Ex. 57 at 16. Prevnar 13 is a conjugate vaccine in which the individual polysaccharides of the capsular antigens of *S. pneumoniae* are linked to a CRM_{197} protein. Id. at 7.

In response to this theory, Dr. He observed that "Dr. Steinman spent a large effort here to search for sequence homologies and cross-reactive epitopes with two important tools in biomedical research: BLAST and the Immune Epitope Database (IEDB)." Resp. Ex. E at 11. Dr. He continued noting that Dr. Steinman identified sequences with five amino acids that might induce neuroinflammatory disease. Id. Relying on Raju et al., Dr. Steinman stated that "humans have been shown to mount T cell responses to these regions of the diphtheria molecule." Id. (quoting Pet. Ex. 57 at 30). Dr. He explained, however, that this "demonstration of sequence homologies between human proteins and microbial pathogen sequences is entirely expected due to recent advances in genomic sequence technologies." Id. at 12. Citing Kanduc et al., Dr. He asserted that "an astonishing 90%" of five amino acid sequences "are widely . . . scattered throughout the human proteome." Id. (citing Resp. Ex. D, Tab 4). He concluded that "it is not surprising to have sequence homologies between CRM_{197} and human proteins." Id.

Additionally, Dr. He asserted that "cross reactivity of T cells and antibodies between self-proteins and infectious agents is widely detectable." Resp. Ex. E at 12. For this reason, Dr. He asserted that three criteria established by the Institute of Medicine ("IOM"),[47] must be fulfilled in order to conclude that molecular mimicry contributes to disease. Id. (citing Resp. Ex. P). These three criteria are:

> (1) a susceptible host whose genetic background and adaptive immune responses allows emergence of self-reactive immunity, (2) exposure to an exogenous agent which expresses antigens that are immunologically similar to self-antigen(s), and (3) a host immune response to the exogenous agent that cross-reacts with biologically relevant host tissue structures and causes tissue damage and clinical disease.

Id. (quoting Resp. Ex. P at 4).

Further, Dr. He quoted additional limitations from the IOM, including that linear homology or similar conformational structure are insufficient to support molecular mimicry.

[47] Inst. of Med., Evaluating Biological Mechanisms of Adverse Events, in Adverse Effects of Vaccines: Evidence and Causality 57 (Kathleen Stratton et al. eds., 2012). The IOM is now the National Academy of Medicine.

Resp. Ex. E at 12. He also argued that in vitro demonstration of cross-reacting antibodies is also not enough proof of molecular mimicry. Id. Instead, there must be an "in vivo pathogenic autoimmune attack" to demonstrate "local binding of antibody with activation . . . of [] pathogenic [] mechanisms in a biologically relevant tissue site." Id. (quoting Resp. Ex. P at 4-5).

3. Medical Literature

Next, Dr. He responded to the literature filed by Petitioner. Regarding the Ravishankar paper, Dr. He criticized the long temporal association, the publication of the case in two different journals, and the low quality of the publications. Resp. Ex. E at 13. As for the paper by Haber et al., Dr. He opined that the study used VAERS data, noting the "huge limitation" with VAERS because "it is a passive reporting system and anyone can report." Id. at 14. He also argued that VAERS reports use "presumptive" diagnoses and do not account for alternative causes. Id. Dr. He also addressed the Tseng et al. study, noting that the study did not show an increased rate of adverse events after the Prevnar 13 vaccine as compared with the 23-valent pneumococcal polysaccharide vaccine. Id. Lastly, Dr. He concluded that there is a "complete lack of epidemiological evidence" between the Prevnar 13 vaccination and the development of GBS. Id.

ii. Althen Prong Two

Dr. He disagreed that there was a logical sequence of cause and effect, arguing that Petitioner had symptoms of an upper respiratory infection on February 27, 2017, and that this infection "was a more likely trigger" of GBS than vaccination. Resp. Ex. E at 15-16.

According to Dr. He, infections are "fundamentally different from vaccinations in the capability to induce immune responses." Resp. Ex. E at 7. He explained the process whereby infections trigger the host immune system in a manner that simulates a "much broader immune response" than vaccines. Id. at 8. Dr. He also described the two major differences between immune responses following infections as compared with vaccination. Id. at 7-8. Dr. He argued that *S. pneumoniae*, "a gram-positive bacterium, is a common cause of [upper respiratory infection]." Id. at 8 (emphasis omitted). Thus, he asserted that Petitioner's upper respiratory infection provided a "much stronger immune stimulus than his [Prevnar 13] vaccination." Id.

Dr. He further opined that Petitioner's upper respiratory symptoms occurred during a timeframe that supports a causal association with GBS. Resp. Ex. E at 14-16.

iii. Althen Prong Three

Dr. He agreed with Dr. Steinman that there was an appropriate temporal association between the Prevnar 13 vaccine the onset of Petitioner's GBS. Resp. Ex. E at 14. Dr. He referenced Dr. Steinman's opinion based on Dr. Diaz's records, where Dr. Diaz indicated that Petitioner had GBS by April 27, 2017. See id. He also agreed with Dr. Steinman's use of the onset interval based on data from the 1976 swine flu immunization campaign, which Dr. He agreed was "often used as a surrogate regarding triggering events" and GBS. Id. Dr. He further

agreed that it "is generally accepted that the 1976/H1N1 swine flu vaccine was associated with increased risk for GBS," and that the period of increased risk was up to 9- or 10-weeks following vaccination. Id.

III. DISCUSSION

A. Standards for Adjudication

The Vaccine Act was established to compensate vaccine-related injuries and deaths. § 10(a). "Congress designed the Vaccine Program to supplement the state law civil tort system as a simple, fair and expeditious means for compensating vaccine-related injured persons. The Program was established to award 'vaccine-injured persons quickly, easily, and with certainty and generosity.'" Rooks v. Sec'y of Health & Hum. Servs., 35 Fed. Cl. 1, 7 (1996) (quoting H.R. Rep. No. 908 at 3, reprinted in 1986 U.S.C.C.A.N. at 6287, 6344).

Petitioner's burden of proof is by a preponderance of the evidence. § 13(a)(1). The preponderance standard requires a petitioner to demonstrate that it is more likely than not that the vaccine at issue caused the injury. Moberly v. Sec'y of Health & Hum. Servs., 592 F.3d 1315, 1322 n.2 (Fed. Cir. 2010). Proof of medical certainty is not required. Bunting v. Sec'y of Health & Hum. Servs., 931 F.2d 867, 873 (Fed. Cir. 1991). Petitioner need not make a specific type of evidentiary showing, i.e., "epidemiologic studies, rechallenge, the presence of pathological markers or genetic predisposition, or general acceptance in the scientific or medical communities to establish a logical sequence of cause and effect." Capizzano v. Sec'y of Health & Hum. Servs., 440 F.3d 1317, 1325 (Fed. Cir. 2006). Instead, Petitioner may satisfy his burden by presenting circumstantial evidence and reliable medical opinions. Id. at 1325-26.

In particular, a petitioner must prove that the vaccine was "not only [the] but-for cause of the injury but also a substantial factor in bringing about the injury." Moberly, 592 F.3d at 1321 (quoting Shyface v. Sec'y of Health & Hum. Servs., 165 F.3d 1344, 1352-53 (Fed. Cir. 1999)); see also Pafford v. Sec'y of Health & Hum. Servs., 451 F.3d 1352, 1355 (Fed. Cir. 2006). The received vaccine, however, need not be the predominant cause of the injury. Shyface, 165 F.3d at 1351. A petitioner who satisfies this burden is entitled to compensation unless Respondent can prove, by a preponderance of the evidence, that the vaccinee's injury is "due to factors unrelated to the administration of the vaccine." § 13(a)(1)(B). However, if a petitioner fails to establish a prima facie case, the burden does not shift. Bradley v. Sec'y of Health & Hum. Servs., 991 F.2d 1570, 1575 (Fed. Cir. 1993).

"Regardless of whether the burden ever shifts to the [R]espondent, the special master may consider the evidence presented by the [R]espondent in determining whether the [P]etitioner has established a prima facie case." Flores v. Sec'y of Health & Hum. Servs., 115 Fed. Cl. 157, 162-63 (2014); see also Stone v. Sec'y of Health & Hum. Servs., 676 F.3d 1373, 1379 (Fed. Cir. 2012) ("[E]vidence of other possible sources of injury can be relevant not only to the 'factors unrelated' defense, but also to whether a prima facie showing has been made that the vaccine was a substantial factor in causing the injury in question."); de Bazan v. Sec'y of Health & Hum. Servs., 539 F.3d 1347, 1353 (Fed. Cir. 2008) ("The government, like any defendant, is permitted to offer evidence to demonstrate the inadequacy of the [P]etitioner's evidence on a requisite

element of the [P]etitioner's case-in-chief."); Pafford, 451 F.3d at 1358-59 ("[T]he presence of multiple potential causative agents makes it difficult to attribute 'but for' causation to the vaccination. . . . [T]he Special Master properly introduced the presence of the other unrelated contemporaneous events as just as likely to have been the triggering event as the vaccinations.").

B. Causation

To receive compensation through the Program, Petitioner must prove either (1) that he suffered a "Table Injury"—i.e., an injury listed on the Vaccine Injury Table—corresponding to a vaccine that he received, or (2) that he suffered an injury that was actually caused by a vaccination. See §§ 11(c)(1), 13(a)(1)(A); Capizzano, 440 F.3d at 1319-20. Petitioner must show that the vaccine was "not only a but-for cause of the injury but also a substantial factor in bringing about the injury." Moberly, 592 F.3d at 1321 (quoting Shyface, 165 F.3d at 1352-53).

Because Petitioner does not allege he suffered a Table Injury, he must prove a vaccine he received actually caused her injury. To do so, Petitioner must establish, by preponderant evidence: "(1) a medical theory causally connecting the vaccination and the injury; (2) a logical sequence of cause and effect showing that the vaccination was the reason for the injury; and (3) a showing of a proximate temporal relationship between vaccination and injury." Althen, 418 F.3d at 1278.

The causation theory must relate to the injury alleged. Petitioner must provide a sound and reliable medical or scientific explanation that pertains specifically to this case, although the explanation need only be "legally probable, not medically or scientifically certain." Knudsen v. Sec'y of Health & Hum. Servs., 35 F.3d 543, 548-49 (Fed. Cir. 1994). Petitioner cannot establish entitlement to compensation based solely on his assertions; rather, a vaccine claim must be supported either by medical records or by the opinion of a medical doctor. § 13(a)(1). In determining whether Petitioner is entitled to compensation, the special master shall consider all material in the record, including "any . . . conclusion, [or] medical judgment . . . which is contained in the record regarding . . . causation." § 13(b)(1)(A). The special master must weigh the submitted evidence and the testimony of the parties' proffered experts and rule in Petitioner's favor when the evidence weighs in her favor. See Moberly, 592 F.3d at 1325-26 ("Finders of fact are entitled—indeed, expected—to make determinations as to the reliability of the evidence presented to them and, if appropriate, as to the credibility of the persons presenting that evidence."); Althen, 418 F.3d at 1280 (noting that "close calls" are resolved in Petitioner's favor).

Testimony that merely expresses the possibility—not the probability—is insufficient, by itself, to substantiate a claim that such an injury occurred. See Waterman v. Sec'y of Health & Hum. Servs., 123 Fed. Cl. 564, 573-74 (2015) (denying Petitioner's motion for review and noting that a possible causal link was not sufficient to meet the preponderance standard). The Federal Circuit has made clear that the mere possibility of a link between a vaccination and a petitioner's injury is not sufficient to satisfy the preponderance standard. Moberly, 592 F.3d at 1322 (emphasizing that "proof of a 'plausible' or 'possible' causal link between the vaccine and the injury" does not equate to proof of causation by a preponderance of the evidence); Boatmon v. Sec'y of Health & Hum. Servs., 941 F.3d 1351, 1359-60 (Fed. Cir. 2019). While certainty is

by no means required, a possible mechanism does not rise to the level of preponderance. Moberly, 592 F.3d at 1322; see also de Bazan, 539 F.3d at 1351.

IV. ANALYSIS

A. Causation

1. Althen Prong One

Under Althen prong one, Petitioner must set forth a medical theory explaining how the received vaccine could have caused the sustained injury. Andreu v. Sec'y of Health & Hum. Servs., 569 F.3d 1367, 1375 (Fed. Cir. 2009); Pafford, 451 F.3d at 1355-56. Petitioner's theory of causation need not be medically or scientifically certain, but it must be informed by a "sound and reliable" medical or scientific explanation. Boatmon, 941 F.3d at 1359; see also Knudsen, 35 F.3d at 548; Veryzer v. Sec'y of Health & Hum. Servs., 98 Fed. Cl. 214, 257 (2011) (noting that special masters are bound by both § 13(b)(1) and Vaccine Rule 8(b)(1) to consider only evidence that is both "relevant" and "reliable"). If Petitioner relies upon a medical opinion to support her theory, the basis for the opinion and the reliability of that basis must be considered in the determination of how much weight to afford the offered opinion. See Broekelschen v. Sec'y of Health & Hum. Servs., 618 F.3d 1339, 1347 (Fed. Cir. 2010) ("The special master's decision often times is based on the credibility of the experts and the relative persuasiveness of their competing theories."); Perreira v. Sec'y of Health & Hum. Servs., 33 F.3d 1375, 1377 n.6 (Fed. Cir. 1994) (stating that an "expert opinion is no better than the soundness of the reasons supporting it" (citing Fehrs v. United States, 620 F.2d 255, 265 (Ct. Cl. 1980))).

For the following reasons, the undersigned finds Petitioner has provided, by preponderant evidence, a sound and reliable theory by which the Prevnar 13 vaccine can cause GBS, and therefore, Petitioner has satisfied the first Althen prong.

Molecular mimicry has long been invoked as the causal mechanism for many different autoimmune diseases, including GBS. Many of the articles filed in this case support the mechanism as a leading hypothesis for the etiology of GBS. The theory has been extended from infectious agents to vaccine-associated autoimmune illnesses, including GBS.

Molecular mimicry has been accepted as a sound and reliable theory in many demyelinating conditions, including GBS, in the Vaccine Program, forming the basis for petitioners to be entitled to compensation. See, e.g., Conte v. Sec'y of Health & Hum. Servs., No. 17-403V, 2020 WL 5743696, at *57 (Fed. Cl. Spec. Mstr. July 27, 2020) (noting the theory of molecular mimicry in a GBS case is "well-established and well-settled in the Vaccine Program"); Barone v. Sec'y of Health & Hum. Servs., No. 11-707V, 2014 WL 6834557, at *8-9 (Fed. Cl. Spec. Mstr. Nov. 12, 2014) (noting molecular mimicry "has been accepted in other Program cases as a reliable medical explanation for how various autoimmune conditions could develop after the receipt of different kinds of vaccinations"); Koller v. Sec'y of Health & Hum. Servs., No. 16-439V, 2021 WL 5027947, at *18 (Fed. Cl. Spec. Mstr. Oct. 8, 2021); Pierson v. Sec'y of Health & Hum. Servs., No. 17-1136V, 2022 WL 322836, at *31 (Fed. Cl. Spec. Mstr. Jan. 19, 2022); Maloney v. Sec'y of Health & Hum. Servs., No. 19-1713V, 2022 WL 1074087

(Fed. Cl. Spec. Mstr. Mar. 17, 2022); Gross v. Sec'y of Health & Hum. Servs., No. 17-1075V, 2022 WL 9669651 (Fed. Cl. Spec. Mstr. Sept. 22, 2022).[48]

Dr. He proposes criteria from the IOM to establish whether a vaccine can cause GBS via molecular mimicry. The criteria include a susceptible host (genetically and via host immune responses), exposure to an exogenous agent that has "expresses antigens that are immunologically similar to self-antigens," and a "host immune response" that causes disease. Resp. Ex. P at 4. Further, there must be evidence of an "in vivo pathogenic autoimmune attack" and demonstration of the pathogenic mechanisms "in a biologically relevant tissue site." Id. Given the state of current scientific knowledge, it would not be possible for a petitioner to satisfy these criteria. Further, fulfilment of these criteria would require scientific certainty, which is a bar too high. See Knudsen, 35 F.3d at 549 (explaining that "to require identification and proof of specific biological mechanisms would be inconsistent with the purpose and nature of the vaccine compensation program").

Moreover, Dr. He does not refute the scientific data or foundational evidence used by Dr. Steinman to support his theories. Dr. Steinman has identified components of the vaccine that could initiate development of antibodies that could cross-react with epitopes on peripheral nerve myelin or axonal glycoproteins. He has identified components of the Prevnar 13 vaccine that could trigger a human antibody response.

Regarding Petitioner's theory based on phosphoglycerol in serotypes 18C and 23F in the vaccine, Dr. Steinman produces papers to show that in MS, myelin phospholipids are targeted by an immune response. He also shows that myelin is comprised of phospholipids, and that phospholipids can serve as autoantigens in autoimmune disorders. He shows that patients with GBS have autoantibodies to phospholipids. In the Gilburd et al. study, the autoantibodies were thought to be due to myelin destruction. However, in Nakos et al., the researchers had a different view. They suggested that anti-phospholipids either "play a role in pathogenesis of the polyneuropathy or represent a part of a more extensive immunoreaction that takes place in GBS." Pet. Ex. 71 at 7. In summary, there is sound support from reputable medical studies for each foundational aspect of Dr. Steinman's phosphoglycerol theory.

There is also evidence to support Dr. Steinman's second theory based on CRM_{197} and Contactin-1. Dr. Steinman identified sequences of shared homology between the proteins in the vaccine and those in Contactin-1.

Additionally, the causal theory proffered by Dr. Steinman here has previously been accepted as sound and reliable in other cases, decided by different special masters, including the undersigned. See, e.g., Maloney, 2022 WL 1074087; Koller, 2021 WL 5027947; Pierson, 2022 WL 322836; Gross, 2022 WL 9669651. While prior decisions are not binding on the undersigned, they can be considered by the undersigned in forming her opinions. See Hanlon v. Sec'y of Health & Hum. Servs., 40 Fed. Cl. 625, 630 (1998), aff'd, 191 F.3d 1344 (Fed. Cir.

[48] The undersigned acknowledges that the first two cases in this string cite involve a different vaccine, although the same illness.

1999); Boatmon, 941 F.3d at 1358. The undersigned agrees with the reasoning offered by her colleagues in these other cases, and for many of the same reasons find the Petitioner's theory here sound and reliable and proven by preponderant evidence.

In another decision addressing the Prevnar 13 vaccine and GBS, the proffered causal theory was unsupported by evidence, and the Chief Special Master found that Petitioner was not entitled to compensation. Deshler v. Sec'y of Health & Hum. Servs., No. 16-1070V, 2020 WL 4593162, at *19 (Fed. Cl. Spec. Mstr. July 1, 2020).[49] There, the Petitioner relied on molecular mimicry, and suggested that there was homology between polysaccharide components of the vaccine and the myelin sheath, but evidence was insufficient to establish the scientific soundness of the theory. Id. at *19-21. Due to the lack of supportive evidence, the Respondent's expert was effective in establishing that the polysaccharides in the vaccine "do not share structural homology with self-structures of the peripheral nervous system, and therefore do not contribute to the pathogenesis of GBS." Id. at *20. In contrast, the theories proffered here are more well-developed and based on supportive foundational evidence from several scientific studies.

For these reasons, the undersigned finds that Petitioner has proven by preponderant evidence a sound and reliable causal theory establishing that the Prevnar 13 vaccine can cause GBS, satisfying Althen prong one.

2. Althen Prong Two

Under Althen prong two, Petitioner must prove by a preponderance of the evidence that there is a "logical sequence of cause and effect showing that the vaccination was the reason for the injury." Capizzano, 440 F.3d at 1324 (quoting Althen, 418 F.3d at 1278). "Petitioner must show that the vaccine was the 'but for' cause of the harm . . . or in other words, that the vaccine was the 'reason for the injury.'" Pafford, 451 F.3d at 1356 (internal citations omitted).

In evaluating whether this prong is satisfied, the opinions and views of the vaccinee's treating physicians are entitled to some weight. Andreu, 569 F.3d at 1367; Capizzano, 440 F.3d at 1326 ("[M]edical records and medical opinion testimony are favored in vaccine cases, as treating physicians are likely to be in the best position to determine whether a 'logical sequence of cause and effect show[s] that the vaccination was the reason for the injury.'" (quoting Althen, 418 F.3d at 1280)). Medical records are generally viewed as trustworthy evidence, since they are created contemporaneously with the treatment of the vaccinee. Cucuras v. Sec'y of Health &

[49] Since Deshler, the Chief Special Master and another special master have found against compensation in other Prevnar 13/GBS cases. See Trollinger v. Sec'y of Health & Hum. Servs., No. 16-473V, 2023 WL 2521912, at *26 (Fed. Cl. Spec. Mstr. Feb. 17, 2023), review denied, 167 Fed. Cl. 127 (2023); Bielak v. Sec'y of Health & Hum. Servs., No. 18-761V, 2023 WL 35509, at *31-32 (Fed. Cl. Spec. Mstr. Jan. 3, 2023); Gamboa-Avila v. Sec'y of Health & Hum. Servs., No. 18-925V, 2023 WL 6536207, at *25 (Fed. Cl. Spec. Mstr. Sept. 11, 2023); McConnell v. Sec'y of Health & Hum. Servs., No. 18-1051V, 2022 WL 4008238, at *9 (Fed. Cl. Spec. Mstr. Aug. 19, 2022). The undersigned acknowledges these cases but also notes that the decisions of other special masters or Court of Federal Claims' judges are not binding on special masters. Boatmon, 941 F.3d at 1358; Hanlon, 40 Fed. Cl. at 630.

Hum. Servs., 993 F.2d 1525, 1528 (Fed. Cir. 1993). While the medical records and opinions of treating physicians must be considered, they are not binding on the special master. § 13(b)(1)(B) (specifically stating that the "diagnosis, conclusion, judgment, test result, report, or summary shall not be binding on the special master or court").

A petitioner need not make a specific type of evidentiary showing, i.e., "epidemiologic studies, rechallenge, the presence of pathological markers or genetic predisposition, or general acceptance in the scientific or medical communities to establish a logical sequence of cause and effect." Capizzano, 440 F.3d at 1325. Instead, Petitioner may satisfy his burden by presenting circumstantial evidence and reliable medical opinions. Id. at 1325-26.

There are three reasons why the undersigned finds preponderant evidence of a logical sequence of cause and effect establishing that the Prevnar 13 vaccination administered to Petitioner on April 12, 2017, was the cause of his GBS. First, Petitioner was appropriately diagnosed with GBS, and Petitioner has proffered a sound and reliable mechanism of vaccine causation.

Second, Petitioner's treating physician, Dr. Diaz, offered evidence in support of vaccine causation. In a follow-up appointment with Dr. Diaz on July 12, 2017, Petitioner was noted to be improving, although he continued to have facial and throat numbness. On examination, Petitioner had strength of 4/5 in all four extremities, however, he had no deep tendon reflexes and decreased sensation in his distal legs and feet. Petitioner reported April 25, 2017 as the onset of his symptoms associated with GBS. Dr. Diaz noted that "[b]ased on the timing and sequence of events, this patient['s] GBS is most likely secondary to the vaccinations received on April 12, 2017." Pet. Ex. 33 at 58.

The undersigned finds that this statement by Dr. Diaz constitutes circumstantial evidence that he associated the Prevnar 13 vaccination administered on April 12, 2017 with the development of Petitioner's GBS.

Third, although Dr. He argues that Petitioner's February 2017 upper respiratory infection is the likely cause of Petitioner's GBS, the undersigned does not find this opinion is supported by preponderant evidence. Moreover, Dr. He did not state his opinion as to alternate cause to a reasonable degree of probability.

The records establish that on February 27, 2017, Petitioner was seen by his primary care provider for a cough, nasal congestion, body aches, and headaches. Flu testing was negative. Petitioner was diagnosed with an upper respiratory infection and was treated with antibiotics (Z-Pak), Albuterol inhaler, and Robitussin.

Petitioner received his Prevnar 13 vaccination on April 12, 2017. Approximately two weeks later, on April 27, 2017, Petitioner complained of numbness in his hands, feet, and lips that began two days before. Petitioner presented to the hospital on April 29, 2017, with numbness in his feet, ankles, wrists, and hands. In the history, there is no mention of any recent infection. There is no reference to cough, cold, sore throat, or other upper respiratory illness. Petitioner had no nausea, vomiting, or abdominal pain. On April 30, 2017, Petitioner was seen

by neurologist, Dr. Rehman. Dr. Rehman wrote, "about [two] weeks ago" Petitioner "had a pneumonia vaccine." Pet. Ex. 30 at 86. Dr. Rehman did not mention any antecedent illness or infection. Dr. Rehman's assessment stated that Petitioner had two vaccinations (pneumonia and shingles) two weeks ago, "consider the possibility of [GBS]." Id. at 87. This note indicates that Dr. Rehman associated the vaccination with the potential diagnosis of GBS. Dr. Rehman did not document any association between Petitioner's symptoms and any illness or infection.

Petitioner was discharged on May 1, 2017, after his lumbar puncture, and resulting cerebrospinal fluid ("CSF") results were normal. Petitioner returned to the hospital on May 2, 2017, with worsening symptoms and was diagnosed with GBS. On admission, history documented that Petitioner had no fevers or chills, and there is no mention of a prior illness or infection. There is no reference to coughing, fever, sore throat, or other symptoms of an upper respiratory illness. Daily progress notes from the date of admission until discharge (May 2 to May 9) do not reference any prior respiratory infection or infection during Petitioner's hospitalization.

Diagnostic testing done during the hospital admission does not show evidence of infection. Lumbar puncture performed on May 3, 2017 revealed CSF elevated protein of 166 (normal 15-45) consistent with GBS, but white blood cell count was normal at 2 (normal 0-5). Pet. Ex. 30 at 681. CSF gram stain showed no bacterial growth. Id. at 684-85. Blood culture drawn on May 5, 2017 also revealed no growth. Id. at 689.

In summary, Petitioner's medical records, physician notes, and diagnostic workup did not identify an infectious or alternate cause of Petitioner's GBS. The only reference to an antecedent event was related to Petitioner's vaccinations on April 12, 2017. The opinions of treating physicians are generally more reliable because they are created contemporaneously with the treatment of the vaccinee. Cucuras, 993 F.2d at 1528.

In conclusion, the undersigned finds that Petitioner has proven by preponderant evidence a logical sequence of cause and effect establishing that the Prevnar 13 vaccination caused his GBS and has satisfied the second Althen prong.

3. Althen Prong Three

Althen prong three requires Petitioner to establish a "proximate temporal relationship" between the vaccination and the injury alleged. Althen, 418 F.3d at 1281. That phrase has been defined as a "medically acceptable temporal relationship." Id. A petitioner must offer "preponderant proof that the onset of symptoms occurred within a timeframe for which, given the medical understanding of the disorder's etiology, it is medically acceptable to infer causation-in-fact." de Bazan, 539 F.3d at 1352. The explanation for what is a medically acceptable time frame must also coincide with the theory of how the relevant vaccine can cause the injury alleged (under Althen Prong One). Id.; Koehn v. Sec'y of Health & Hum. Servs., 773 F.3d 1579, 1243 (Fed. Cir. 2014); Shapiro, 101 Fed. Cl. at 542 (2011), recons. den'd after remand, 105 Fed. Cl. 353 (2012), aff'd mem., 503 F. App'x 952 (Fed. Cir. 2013).

Here, Respondent's experts do not disagree that there is a temporal association between Petitioner's vaccination and onset of GBS. Petitioner received his Prevnar 13 vaccination on April 12, 2017, and presented with symptoms on April 27. Onset was approximately two weeks after vaccination.

This time frame from vaccination to the initial manifestation of symptoms is appropriate given the theory of molecular mimicry, as demonstrated in the Haber et al. article, which reported 11 cases of GBS following a Prevnar 13 vaccine, with a median onset interval of nine days. This temporal association is also consistent with the onset period of three to 42 days as set forth in the Vaccine Injury Table for GBS following flu vaccination. 42 C.F.R. § 100.3(a)(XIV)(D).

Further, this time frame has been acknowledged as appropriate in other Vaccine Program cases in which molecular mimicry has been proffered as the causal mechanism. See, e.g., Maloney, 2022 WL 1074087, at *36 (finding a GBS onset of seven days after Prevnar 13 vaccination to be appropriate); Koller, 2021 WL 5027947, at *57 (finding a GBS onset of 12 days after Prevnar 13 vaccination to be "within the medically accepted timeframe consistent with [P]etitioner's theory of molecular mimicry [and] that has been accepted in other Vaccine Program cases"); Barone, 2014 WL 6834557, at *13 ("[S]pecial masters have never gone beyond a two-month (meaning eight week) interval in holding that a vaccination caused a demyelinating illness."); Gross, 2022 WL 9669651, at *38-39 (finding a GBS onset of 13 days after Prevnar 13 vaccination to be appropriate).

Therefore, undersigned finds that Petitioner has met her burden of proof as to Althen prong three.

V. CONCLUSION

Based on the record, and for the reasons discussed above, the undersigned finds there is preponderant evidence to satisfy all three Althen prongs and to establish that Petitioner's Prevnar 13 vaccination caused his GBS. Thus, the undersigned finds that Petitioner is entitled to compensation. A separate damages order will issue.

IT IS SO ORDERED.

s/Nora Beth Dorsey
Nora Beth Dorsey
Special Master